The Value of Distillers Dried Grains With Solubles (DDGS) in Pig Diets

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DDGS Production and Use

- 3.2 to 3.5 million MT of DDGS is produced annually in North America
  - ~ 900,000 MT are produced in MN-Dakota region
  - ~ 700,000 MT are exported to the EU
  - ~ 2.65 million MT are fed in U.S. and Canada
    - ~ 2.58 million MT (80%) fed to ruminants
    - ~ 45,000 MT fed in MN turkey industry
    - < 27,000 MT used in swine diets
Distribution of Use of DDGS Produced in North America
Why Hasn’t DDGS Been Used in Swine Diets?

- Variability of nutrient levels
  - type of grain used
  - variability of corn quality
  - amount of solubles added
- Low amino acid digestibility
  - variable heating and color
- High crude fiber
  - Low and variable DE and ME estimates
Why Hasn’t DDGS Been Used in Swine Diets?

• **Amino Acid Profile**
  – amino acid balance is not well suited to the pig (low lysine)
  – amino acid imbalance is amplified 3x in DDGS compared to corn

• **Limited recent information on use of DDGS in swine diets**

• **Cost competitiveness relative to commonly used energy and amino acid ingredients**
Why is There Renewed Interest in Feeding DDGS to Swine?

- Increasing quantities
  - increased ethanol production to meet oxygenated fuel demand
- New ethanol plants
  - improved fermentation technology = higher feeding value?
- Reduced nutrient variability?
  - corn supply from smaller geographic regions
- High P availability = reduced P excretion
- Reduce odor emissions?
Evaluation of the Feeding Value of “New” DDGS

- Ethanol plants participating in DDGS evaluation:
  - Aberdeen, SD
  - Bingham Lake, MN
  - Luverne, MN
  - Preston, MN
  - Winnebago, MN
  - Benson, MN
  - Claremont, MN
  - Morris, MN
  - Scotland, SD
  - Winthrop, MN
How Do Nutrient Levels of MNSD DDGS Compare to Published Values?
MNSD DDGS Dry Matter (%) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 1.25
MNSD DDGS Crude Fiber (%) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 0.63
MNSD DDGS Crude Fat (%) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 1.02
MNSD DDGS Metabolizable Energy (kcal/kg) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 34.0

![Bar chart showing estimated metabolizable energy (ME) in kcal/kg for different sources: MNSD, MW, NRC, HL, and FDST.](image-url)
MNSD DDGS Crude Protein (%) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 1.49
MNSD DDGS Total and Apparent Digestible Lysine (%) vs. DDGS from an Older Midwestern Plant and Published Values
MNSD DDGS Total and Apparent Digestible Methionine (%) vs. DDGS from an Older Midwestern Plant and Published Values
MNSD DDGS Total and Apparent Threonine (%) vs. DDGS from an Older Midwestern Plant and Published Values
MNSD DDGS Total and Apparent Digestible Tryptophan (%) vs. DDGS from an Older Midwestern Plant and Published Values
## Summary - Dig AA Levels

<table>
<thead>
<tr>
<th>App. Dig. AA</th>
<th>MNSD</th>
<th>OMP</th>
<th>NRC (1998)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysine, %</td>
<td>.44</td>
<td>.00</td>
<td>.31</td>
</tr>
<tr>
<td>Methionine, %</td>
<td>.32</td>
<td>.24</td>
<td>.39</td>
</tr>
<tr>
<td>Threonine, %</td>
<td>.62</td>
<td>.36</td>
<td>.56</td>
</tr>
<tr>
<td>Tryptophan, %</td>
<td>.15</td>
<td>.15</td>
<td>.14</td>
</tr>
<tr>
<td>Valine, %</td>
<td>.92</td>
<td>.51</td>
<td>.88</td>
</tr>
</tbody>
</table>
MNSD DDGS Phosphorus (%) vs. DDGS from an Older Midwestern Plant and Published Values

C.V. = 0.09
Summary of Nutrient Level Comparisons vs. NRC 1998

- MNSD DDGS is higher in:
  - crude fat
  - crude fiber
  - DE and ME
  - crude protein
  - total and apparent digestible lysine
  - total and apparent digestible threonine
  - phosphorus

- MNSD DDGS is lower in:
  - dry matter
  - apparent digestible methionine
What Are the Effects of DDGS on Manure Nutrient Management and Air Quality?
**Effects of DDGS on Manure Nitrogen Excretion**

- **THE BAD NEWS**
  - Nitrogen content increases due to:
    - high crude protein:lysine ratio
    - reduced a.a. digestibility compared to corn & SBM
  - Excess N can be minimized by adding synthetic amino acids to the diet
  - High levels of DDGS may reduce pig performance due to the high energy cost of removing excess N
  - May increase ammonia emissions?
Effects of DDGS on Manure Phosphorus Excretion

• THE GOOD NEWS
  – Phosphorus content is reduced due to:
    • increased phosphorus content and bioavailability compared to corn and SBM
  – Decreases the amount of supplemental inorganic P or phytase to the diet.
    • Decreases diet cost
Effects of DDGS on Air Quality

- Feeding DDGS increases N excretion
- Increased N excretion may increase ammonia emissions
- Increasing non-starch polysaccharides in the diet reduces ammonia emissions
## Comparison of Fiber Characteristics of MNDAK DDGS with Other High Fiber Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Crude Fiber, %</th>
<th>NDF, %</th>
<th>ADF, %</th>
<th>Soluble Fiber, %</th>
<th>Insoluble Fiber, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>2.6</td>
<td>9.0</td>
<td>3.0</td>
<td>1.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>7.0</td>
<td>13.3</td>
<td>9.4</td>
<td>1.6</td>
<td>13.2</td>
</tr>
<tr>
<td>MNDAK DDGS</td>
<td>9.9</td>
<td>44</td>
<td>18</td>
<td>0.7</td>
<td>42.2</td>
</tr>
<tr>
<td>Beet pulp</td>
<td>19.8</td>
<td>54</td>
<td>33</td>
<td>11.7</td>
<td>53.9</td>
</tr>
<tr>
<td>Soybean hulls</td>
<td>40.1</td>
<td>67</td>
<td>50</td>
<td>8.4</td>
<td>75.5</td>
</tr>
</tbody>
</table>
Expected curve of odor and gas emissions

ppm or ODU

week

Odor or gas
Effect of Dietary Treatment on Manure Odor Detection Threshold

- **Control**
- **DDGS**

Week 0: Control 258, DDGS 333
Week 2: Control 500, DDGS 666
Week 5: Control 1500, DDGS 1666
Week 8: Control 2000, DDGS 2000

MSE ± .1152  P > .10
Effect of Dietary Treatment on Ammonia Emission

![Graph showing the effect of dietary treatment on ammonia emission. The graph compares control and DDGS treatments over 9 weeks. The y-axis represents ammonia (NH₃) concentration in ppm, and the x-axis represents weeks. The MSE ± 0.0876 and P > 0.10 indicate statistical analysis results.]
Effect of Dietary Treatment on Hydrogen Sulfide Emission
How Does This Information Apply to Practical Swine Diets?

- Maximum recommended inclusion rates were based on old diet formulation approaches and DDGS nutrient values.
## Recommended Maximum Inclusion Rates for DDGS

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Nursery</td>
<td>5 %</td>
<td>5 %</td>
</tr>
<tr>
<td>Growing pigs (18-55 kg)</td>
<td>7.5 %</td>
<td>10 %</td>
</tr>
<tr>
<td>Finishing pigs (55 kg to mkt)</td>
<td>10 %</td>
<td>10 %</td>
</tr>
<tr>
<td>Gestating sows</td>
<td>50 %</td>
<td>40 %</td>
</tr>
<tr>
<td>Lactating sows</td>
<td>20 %</td>
<td>10 %</td>
</tr>
</tbody>
</table>
How Does This Information Apply to Practical Swine Diets?

- It depends upon accuracy of energy values.
Net Effects of Adding 100 lbs MNSD DDGS to Grower Diets

- 3032 kcal ME/kg
  - - 93.6 lbs corn
  - - 11.7 lbs soybean meal
  - + 6.9 lbs fat
  - + 1.8 lbs limestone
  - - 3.4 lbs dicalcium P
  - - $0.20/100 lbs
Net Effects of Adding 100 lbs MNSD DDGS to Grower Diets

- 3917 kcal ME/kg
  - - 72.2 lbs corn
  - - 13.2 lbs soybean meal
  - + 13.0 lbs fat
  - + 1.8 lbs limestone
  - - 3.4 lbs dicalcium P
  - - $1.98/100 lbs
How Does This Information Apply to Practical Swine Diets?

• It depends upon accuracy of amino acid ratios.
Effects of Adding 15 and 30% MNSD DDGS to Practical Swine Grower Diets Using Total (T) or Apparent Amino Acid Digestibility (AD) Ratios on Ingredient Levels

<table>
<thead>
<tr>
<th></th>
<th>(T)C-S-L</th>
<th>(T)15% D</th>
<th>(T)30% D</th>
<th>(AD)15% D</th>
<th>(AD)30% D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn, %</td>
<td>73.3</td>
<td>66.5</td>
<td>57.1</td>
<td>62.2</td>
<td>51.2</td>
</tr>
<tr>
<td>SBM, %</td>
<td>24.1</td>
<td>15.9</td>
<td>10.4</td>
<td>20.3</td>
<td>16.6</td>
</tr>
<tr>
<td>DDGS, %</td>
<td>0</td>
<td>15.0</td>
<td>30.0</td>
<td>15.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.75</td>
<td>1.05</td>
<td>1.35</td>
<td>1.02</td>
<td>1.30</td>
</tr>
<tr>
<td>Dical P</td>
<td>1.2</td>
<td>0.75</td>
<td>0.25</td>
<td>0.71</td>
<td>0.21</td>
</tr>
<tr>
<td>L-lysine</td>
<td>0.15</td>
<td>0.33</td>
<td>0.44</td>
<td>0.21</td>
<td>0.26</td>
</tr>
<tr>
<td>$/ton</td>
<td>100.68</td>
<td>96.87</td>
<td>94.51</td>
<td>96.60</td>
<td>93.42</td>
</tr>
</tbody>
</table>
Effects of Adding 15 and 30% MNSD DDGS to Practical Swine Grower Diets Using Total (T) or Apparent Amino Acid Digestibility (AD) Ratios on Amino Acid Balance

<table>
<thead>
<tr>
<th>Amino Acid</th>
<th>Ideal</th>
<th>(T) CS-L</th>
<th>(T) 15% DDGS</th>
<th>(T) 30% DDGS</th>
<th>(AD) 15% DDGS</th>
<th>(AD) 30% DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lys</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Met + Cys</td>
<td>57</td>
<td>59</td>
<td>63</td>
<td>69</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Thr</td>
<td>65</td>
<td>67</td>
<td>67</td>
<td>71</td>
<td>56</td>
<td>55</td>
</tr>
<tr>
<td>Trp</td>
<td>18</td>
<td>20</td>
<td>19</td>
<td>18</td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>
Summary

• **MNSD DDGS:**
  - has higher levels and digestibility of most key nutrients
  - has less variability in nutrient levels
  - may not reduce or improve air quality
  - will reduce P excretion
  - can likely be added at higher inclusion rates than previously recommended to reduce cost while maintaining performance